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A CASE STUDY

Sustainable development in the field of agriculture using the remote sensing and GIS technology

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Sustainable agricultural development requires a systematic effort towards the planning of land use activities in the most appropriate way, apart from several other institutional and policy programmed initiative. Remote sensing can provide valuable and timely information about natural resources and environment as an important basis for sustainable development. Geographic information systems (GIS) can provide effective tools for decision makers. Both RS and GIS techniques are important geometric tools which are extensively utilized in developed countries. This technology is also used for land use planning and soil mapping. Modern tools such as satellite remote sensing and geographical information system (GIS) have been providing newer dimensions to effectively monitor and manage land uses in an integrated manner for agricultural characterization. Remote sensor and G.I.S. is an excellent tool that is increasingly important in the detection, description, quantification and monitoring environmental changes is remote sensing, which, in combination with geographic information systems and fieldwork, is an effective management tool.

Key words : Remote sensing, GIS, Geometric, Tools, Agricultural, Sustainability

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INTRODUCTION

Geographic data record the locations and characteristics of natural features that occur on are near earth's surface. Agriculture statistics plays an important role in national planning and proper allocation of limited resource to the different sector of economy in the country (Csatho *et al.*, 1999 and Nair *et al.*, 2000). The problem of low land-to-people ratio is further compounded by land degradation by way of accelerated soil erosion by water and wind, salinization and/alkalization, water logging, compaction; mining and depletion of organic matter. With only 55 per cent of the geographical area of the world, the developing countries carry 75 per cent of the world population which leads to over-exploitation of natural resources (De Wulf *et al.*, 1990). Over exploitation of available natural resources for meeting the growing demand for food, fuel and fibre of an ever-increasing population has led to serious environmental degradation. Globally, 1964.4 x 10^6 ha land is affected by human induced degradation. Of this, 1,903x106ha are subject to soil erosion by water, 548.3x10^6 ha to wind erosion, 239.1x10^6 ha to chemical deterioration, 68.2x10^6 ha to compaction and 10.5x10^6 ha to water logging. Furthermore, rapid industrialization coupled with the deforestation has led to building up of green house gases in the atmosphere resulting in global warming (Ellis and Kalumbi, 1998).

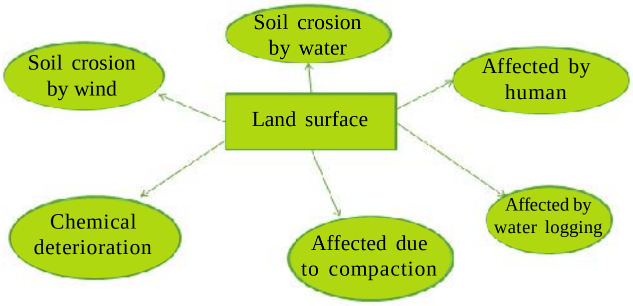

Fig. 1 : Land surface details

In this time the use of remote sensing techniques widely increase due to best method of facing problem. Remote sensing has potential to detect, map and monitor degradation problems. Remote sensing has been viewed as the one of the most effective tools for environment monitoring, urban resources and environment investigation, changes detection, agricultural field condition and urban growth analysis in mining industrial cities (Franklin *et al.*, 1991).

What is agriculture sustainability?

In simplest terms, sustainable agriculture is the production of food, fibre, or other plant or animal products using farming techniques (remote sensor and GIS) that protect the environment, public health, human communities, and animal welfare (Gennari *et al.*, 2002 and Polidoro *et al.*, 1991). Sustained campaign and awareness amongst agriculturists about sustainable development these days has led farmers to manage their fields more proficiently. Interest is driven by consumer demand for locally grown, organic and sustainable products. But still a lot more is required to be done (Clague, 1997). Agriculture is the backbone of Indian economy and it is the provider of livelihood for nearly half of the working population. Sustainable development of natural resources refers to maintaining a critical balance between productivity functions and conservation practices through identification and monitoring of problem areas and calls for optimal utilization of available natural resources based on their potentials and limitations while maintaining a good harmony with the environment (Satake *et al.*, 1996).

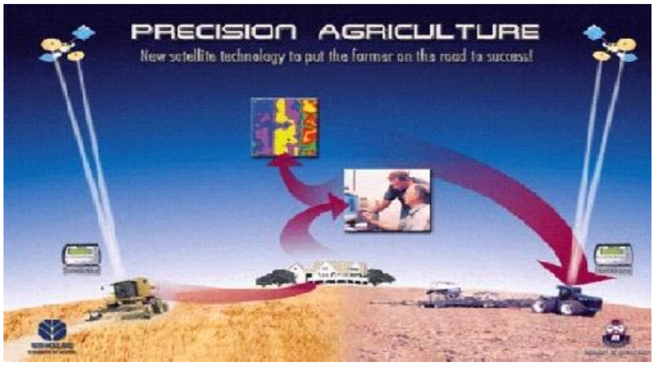
PRECISION AGRICULTURE
New satellite technology to put the farmer on the road to success!

Fig. 2 : Process of sustainable development in agriculture "New satellite technology to put the former on the road to success"

Development of ideas about agricultural sustainability :

The idea of sustainable development became a widespread concern when people concluded that the current path of human activity was unsustainable in the long term and changes in the human society were needed. So long as man was ignorant about modern farm practices, he had stuck to the farming that is now thought of being sustainable and beneficial in the long term (Lachman *et al.*, 1961). Organic farming was the original type of agriculture that had been practiced from time immemorial. It is the form of farming which relies on techniques such as crop rotation, green manure, compost and biological pest control (Lomnitz, 1970 and Rousset *et al.*, 1987).

Fig. 3 : Development in agriculture field

For creating digital soil maps. Through near infrared and short-wave infrared sensors, satellites measure spectral reflectance in soils on the ground. Different materials reflect and absorb solar radiation at a variety of wavelengths (Fig. 4). As a result, remote sensors can measure soil colour, texture (sand, silt, and clay), organic matter, moisture, salinity and absorption processes by detecting and observing the solar radiation reflected (orbit sensing). Reflectance changes depending on the soil's contents; for example, reflectance is low in areas with low silt content. This technology gives researchers an accurate assessment of soil properties to use in GIS and computer modeling for digital soil maps (Plafker and Savage, 1970 and Singh and Yasir, 2011).

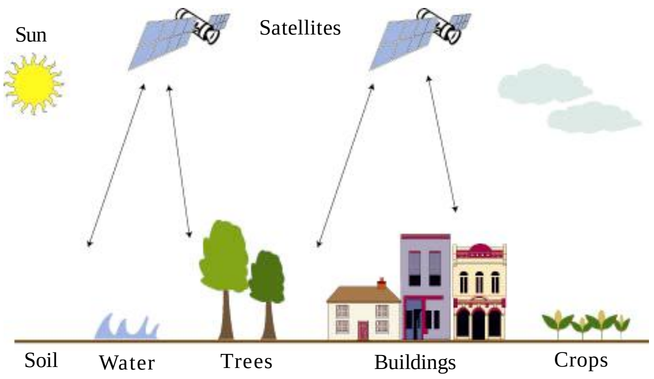

Fig. 4 : Observation of earth by satellite

GIS for sustainable agriculture development:

Providing the current population and future generations with an indefinite food supply is an economic, environmental, and social concern.Geographic information system (GIS) technology enables community planners, economists, agronomists and farmers to research and devise practices that will enable the sustainability of food production to ensure the survival of the human race (Saint-Amand, 1963). Whether implementing organic farming methods, finding the most profitable and healthy places to plant new crops, or allotting farmland for preservation to secure future food production, GIS has the capabilities to collect, manage, analyze, report, and share vast amounts of agricultural data to aid in discovering and establishing sustainable agriculture practices. People working in agribusiness use GIS software for precision farming, land management, business operations, and much more. GIS provides the means to spatially view variables that affect crop yields, erosion and drought risk, and business opportunities (Weerasinghe *et al.*, 2011). Farmers are now able to access online agricultural data from government services such as the USDA's soil assessment data or NOAA's weather and climate data and integrate it into their mapping projects. GIS mobile technology provides the means to access and collect agriculturally relevant data in the field for pest management, soil treatment, and weed deficiency. Sustainable development agencies use GIS to predict drought conditions. Monitor water resources, visualize remote-sensing data (Tarawneh *et al.*, 2008 and Whitley *et al.*, 1989).

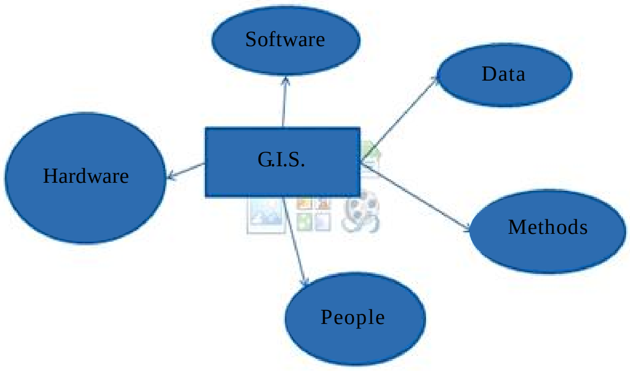

Fig. 5 : GIS operation

Remote sensing for sustainable agriculture development :

Remote sensing has been viewed as the one of the most effective tools for environment monitoring. Space technologies have been successfully utilized worldwide in natural resources and disaster management, with the availability of high-resolution remote sensing data, monitoring of land, water resource and coasting at local scales has become

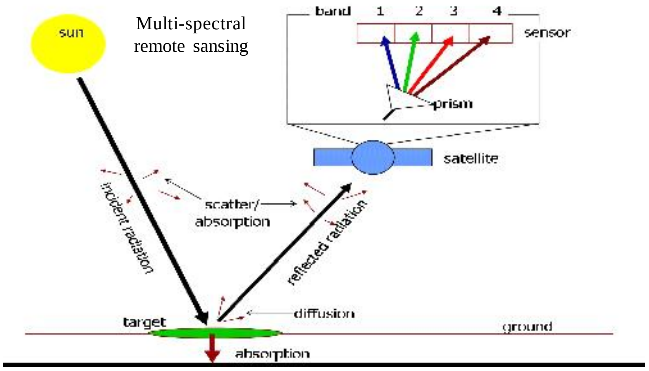

Fig. 6 : Working of remote sensor as a passive

possible to resource managers as a way to create timely and reliable assessments. However, with respect to island ecosystem management, realization of advantage of remote sensing data for small island developing states depends upon the ability to derive incidental and detailed local information from remote sensing data and integrating it with other non-spatial information (Baader *et al.*,2004 and Yu, 2009).

Three recent innovations in remote sensing (radar, hyper spectral imaging and high spatial resolution) offer promising techniques to assist sustainable development (Zalmanson, 2000). Radar is frequently referred as a solution for mapping the structure of vegetation as well as the moisture of soils and geographical patterns. Hyper spectral remotely sensed data provide information on vegetation floristic, soil type and soil chemistry (Bo *et al.*, 1999).

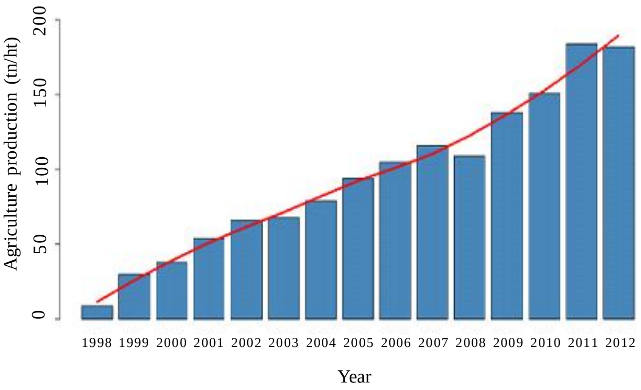

Fig. 7 : Agriculture production increment yearly

Application of remote sensing and GIS in this field :

- Crop acreage estimation, crop modeling for yield and production forecast / estimation
- Water logging and salinity benefits, assessment of spatial distribution of land resources.
- Timely availability of crop statistics for decision making and planning.
- Soil status monitoring.
- Land use / land cover mapping scope, infrastructure monitoring, availability of usable land, future planning for better land management for socio-economic development.
- Sustainability of environment (Miyata and Takagi, 2004).

Conclusion :

Recent development in remote sensing and GIS hold much promise to enhance the integrated management of all the available information and desired information to promote sustainable agriculture and development. In the end it is important to reinforce training in these new fields.

"We want to help those countries fight with hunger and poverty. One of the best ways to do this is through agricultural development."

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